



## Selected Papers on Protoplanetary Disks

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Three papers present studies of thermal balances, dynamics, and electromagnetic spectra of protoplanetary disks, which comprise gas and dust orbiting young stars. One paper addresses the reprocessing, in a disk, of photons that originate in the disk itself in addition to photons that originate in the stellar object at the center. The shape of the disk is found to strongly affect the redistribution of energy. Another of the three papers reviews an increase in the optical luminosity of the young star FU Orionis. The increase

began in the year 1936 and similar increases have since been observed in other stars. The paper summarizes astronomical, meteoric, and theoretical evidence that these increases are caused by increases in mass fluxes through the inner portions of the protoplanetary disks of these stars. The remaining paper presents a mathematical-modeling study of the structures of protostellar accretion disks, with emphasis on limits on disk flaring. Among the conclusions reached in the study are that (1) the radius at which

a disk becomes shadowed from its central stellar object depends on radial mass flow and (2) most planet formation has occurred in environments unheated by stellar radiation.

*This work was done by K. R. Bell and P. M. Cassen of Ames Research Center, J. T. Wasson and D. S. Woolum of the University of California, and H. H. Klahr and Th. Henning of the Max Planck Society (Jena, Germany). Further information is contained in a TSP (see page 1).*

ARC-14986

## Module for Oxygenating Water Without Generating Bubbles

No bubbles were observed at any of the test flow rates.

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A module that dissolves oxygen in water at concentrations approaching saturation, without generating bubbles of oxygen gas, has been developed as a prototype of improved oxygenators for water-disinfection and water-purification systems that utilize photocatalyzed redox reactions. Depending on the specific nature of a water-treatment system, it is desirable to prevent the formation of bubbles

for one or more reasons: (1) Bubbles can remove some organic contaminants from the liquid phase to the gas phase, thereby introducing a gas-treatment problem that complicates the overall water-treatment problem; and/or (2) in some systems (e.g., those that must function in microgravity or in any orientation in normal Earth gravity), bubbles can interfere with the flow of the liquid phase.

The present oxygenation module (see Figure 1) is a modified version of a commercial module that contains >100 hollow polypropylene fibers with a nominal pore size of 0.05  $\mu\text{m}$  and a total surface area of 0.5  $\text{m}^2$ . The module was originally designed for oxygenation in a bioreactor, with no water flowing around or inside the tubes. The modification, made to enable the use of the module to oxygenate

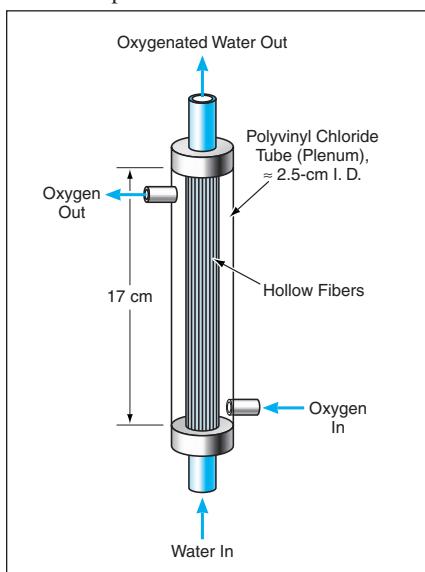


Figure 1. Hollow, Porous Polypropylene Fibers contain flowing water. Oxygen diffuses through the fiber walls and is dissolved in the water.

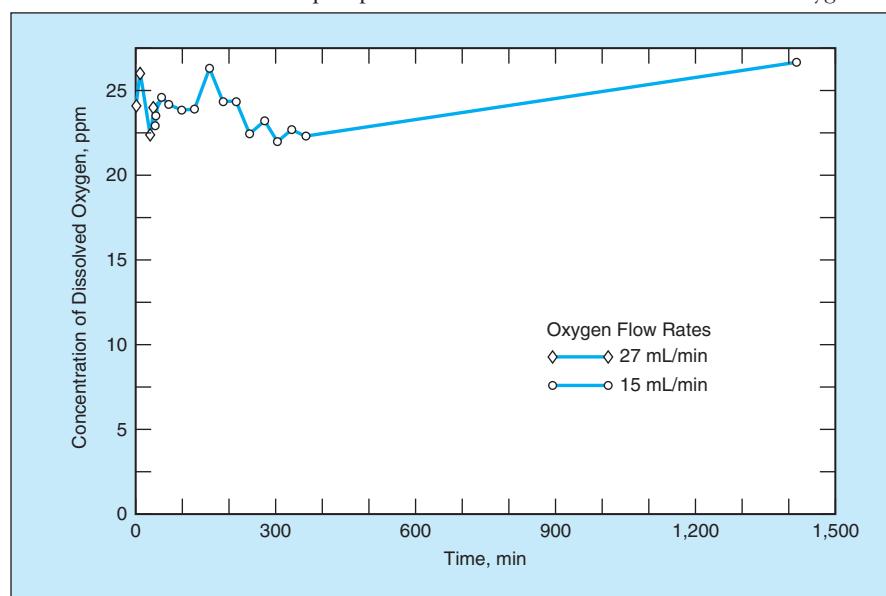


Figure 2. The Concentration of Dissolved Oxygen as a function of time was measured with water flowing through the module at a rate of 300 mL and with two different oxygen-flow rates.